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(54) Method for feeding pieces of timber into a timber processing machine and arrangement for carrying out the method

(57) The method and arrangement work according to the principle that the contours in the longitudinal direction of the piece of timber (10A) are first measured by measuring devices (22, 23) which exert minimal pressure on the piece of timber, after which the piece of timber is advanced to at least one control device (32, 33) which is arranged immediately adjacent to the processing machine and acts laterally upon the piece of timber with a considerably larger alignment force. Measurement signals from measuring devices are processed in a known manner in a computer (D) from which the order signals are sent to the control unit with a determined delay. The control device operates both as an alignment device, by aligning the piece of timber to the necessary feed attitude calculated in the computer, and as a control device in the stricter sense of the term by controlling the piece of timber while it is being fed into the processing machine. The control devices may be positioned to one side of the measuring devices.

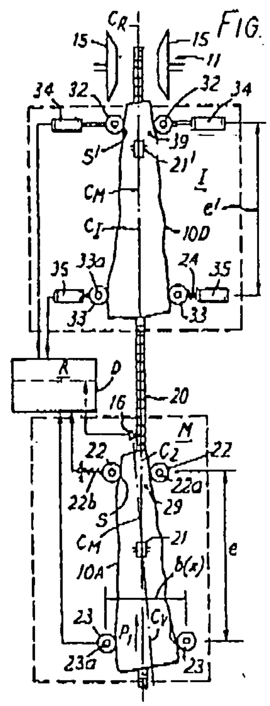

FIG. 1

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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FIG.1

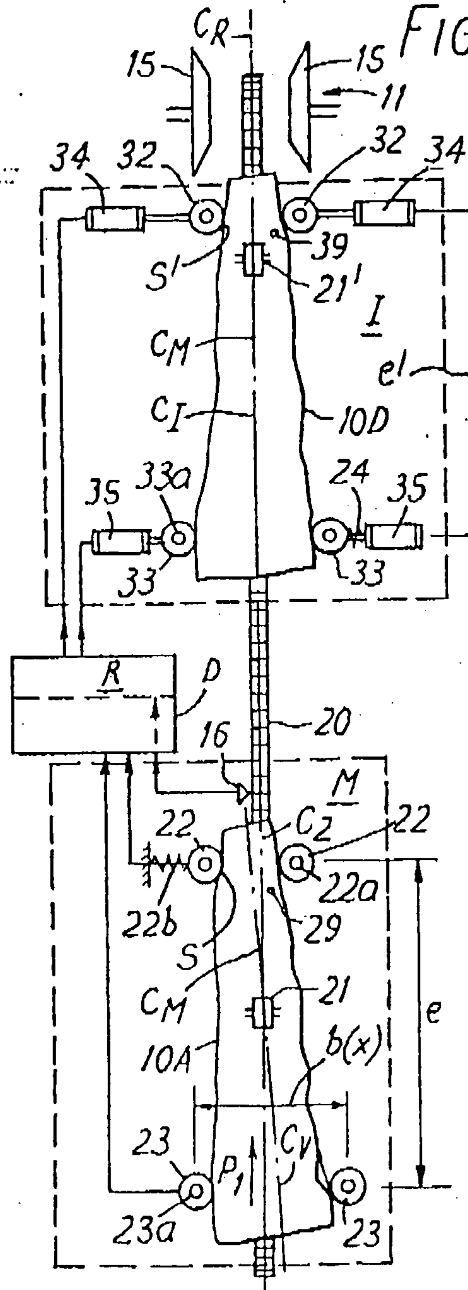

FIG.3

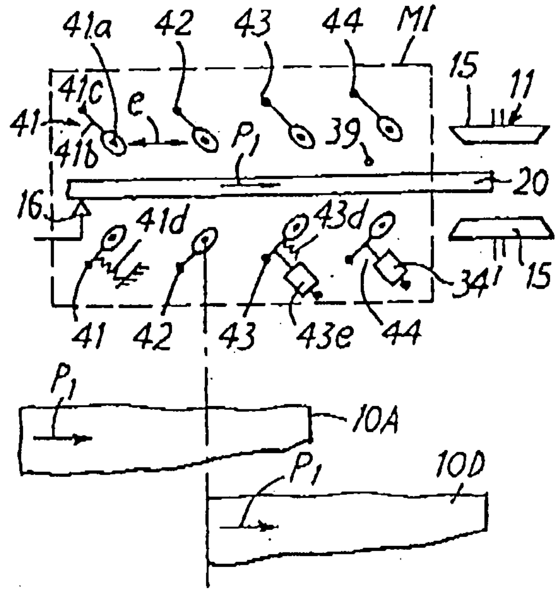

FIG.4a

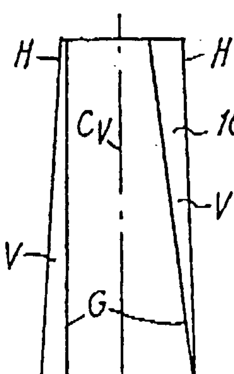

FIG.4b

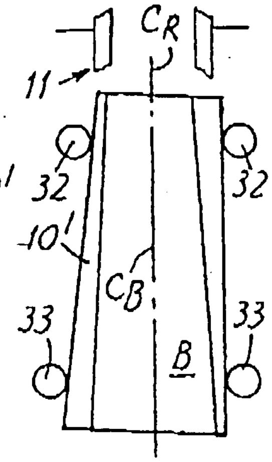

FIG.5

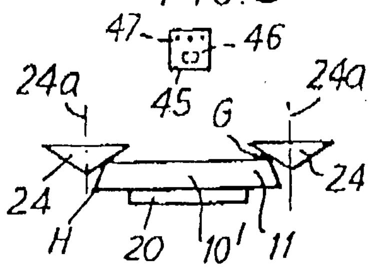

FIG.6

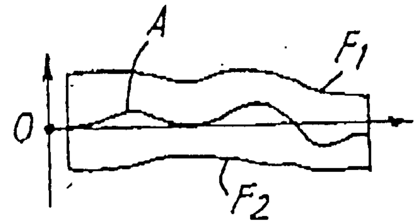

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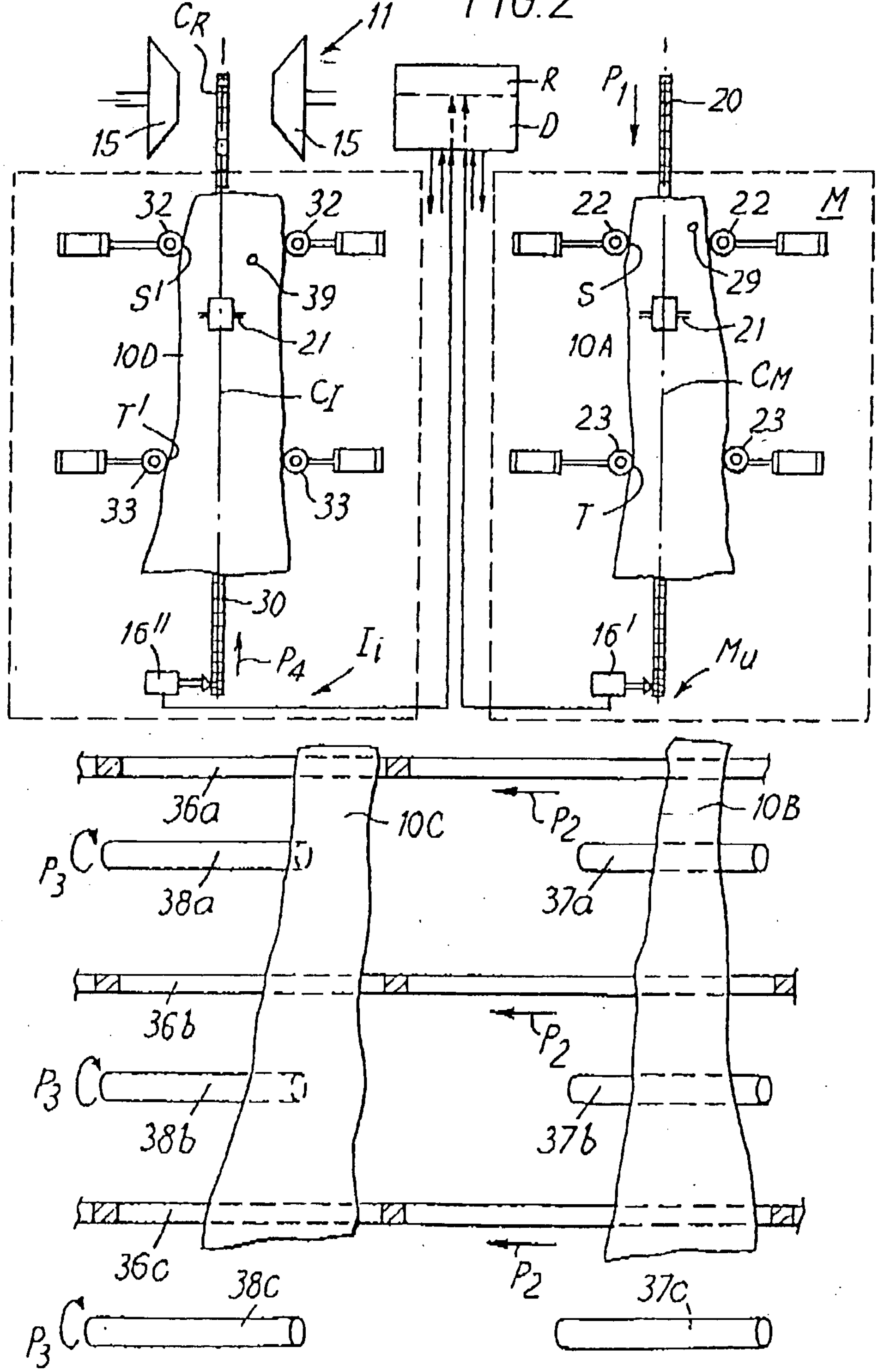
FIG. 2



SPECIFICATION

Method for feeding pieces of timber into a timber processing machine and arrangement for carrying out the method

The invention relates to a method and an arrangement for feeding pieces of timber into a timber processing machine. Pieces of timber here means elongated lengths of timber which have a centre line and which possess in the longitudinal direction either only outside contours (such as logs) or both outside contours and measurable inside contours (blocks, planks, boards). A timber processing machine, which also has a centre line, here means a sawing machine, a reducer, a reducing and sawing machine or some other such machine. To achieve the optimum yield from a piece of timber, the piece of timber should be fed into the processing machine in a particular feed attitude, which can be defined, for example, in terms of the position relationship between the centre lines of the piece of timber and the processing machine.

Methods are already known in which the longitudinal contours of a piece of timber are sensed or measured by an optical or mechanical measuring system which feeds the measurement results in the form of electrical signals to a computer system in which the optimum yield and the feed attitude required to achieve it is determined, and in which control signals are produced, on the basis of which the piece of timber is lined up in the necessary feed attitude by special alignment devices. An arrangement of this kind is described in the applicant's Swedish patent specification 7610080, for example.

Methods are likewise known in which, for planks and other pieces of timber which, in the longitudinal direction, have inside contours as well as outside contours, the inside contours are used in the computer as a basis for determining the optimum yield, since it is these, and not the outside contours, that determine the volume of sound wood.

Both optical and mechanical measuring devices for recording the outside contours and/or the inside contours are known and are described, for example, in Swedish patent specification 381 334 and in German patent application 27 06 149.

The weakest link in all hitherto known arrangements for feeding pieces of timber into a timber processing machine is the mechanical holding or location of the piece of timber when, during the feed sequence, it has already been engaged by the processing tools of the machine, and is thus subjected to the effect of by no means insignificant lateral forces. However sophisticated the measurement of the geometry of the piece of timber and its relative position may be, the results cannot be more accurate than the performance of the control equipment, and with optical measuring systems in particular, the alignment stage is often a basic weakness.

The purpose of the present invention is to overcome the above-mentioned disadvantage and to build on the general idea that the longitudinal contours of the piece of timber (outside contours or, where applicable, outside and inside contours) are to be measured during the longitudinal forward feeding of the piece of timber, in other words during a forward feeding motion of the same kind as the motion with which the piece of timber is fed into the processing machine, and with measuring devices which do not exert any significant lateral force on the piece of timber (or no force at all). Alignment is to be achieved during feeding-in at the same time as guiding, and is to be performed by devices which apply lateral force to the piece of timber and which jointly "re-create" the longitudinal contour form of the piece of timber, calculated in the measuring system, but generally in a corrected position (relative to the centre line of the processing machine). The sawing technique in which a piece of timber with a curved centre line is continuously rotated during feeding about an axis perpendicular to the feed centre line, is also to be possible.

The invention is characterised by the features stated in the attached claims, and will now be explained, by way of example, with reference to the accompanying diagrammatic drawings, in which: Fig. 1 is a plan view of a first embodiment of an arrangement according to the invention, Fig. 2 is a plan view of a second embodiment, Fig. 3 is a plan view of a third embodiment, Figs. 4a and 4b shows a board with waney edges in two different positions, Fig. 5 shows the measurement of the inside and outside contours of a board according to Fig. 4a, and Fig. 6 shows in a diagram examples of the behaviour of the signal obtained in a measuring system.

According to Fig. 1, a log 10A is moved on a longitudinal conveyor (chain conveyor) 20 which is driven in the direction of the arrow P_1 in a known manner, not shown in the drawing. The log is pressed against the conveyor by one or more retaining rollers 21 above the log with such a force that the log is fixed in position relative to the conveyor. Log 10A is in the process of passing through a measuring station *M* in which there is arranged a measuring system that includes two measuring devices, each comprising a pair of contact rollers 22, 23 with vertical spindles 22a, 23a. The pairs of rollers are arranged a distance *e* apart, where *e* is preferably 2 m (for the measurement of pieces of timber at least 4 m long). The contact rollers can move freely transversely to conveyor 20, and pressure devices, for example a helical spring 22b, which for clarity is shown only on con-

tact roller 22, press the contact rollers against log 10A, but with such a small force that the position of the log on conveyor 20, held by retaining roller 21, is not affected. The distance apart of each pair of contact rollers ("the opening width"), and their position relative to the centre line C_M of the measuring station is continuously sensed and is fed to a computer *D* as a continuous sequence of signals from each measuring device. For clarity only the connection between the left-hand contact rollers and the computer have been drawn in Fig. 1, although obviously the positions of the right-hand rollers are fed to the computer. The forward motion of log 10A through measuring station *M* is also sensed and fed to the computer *D*; this can be done either by means of a separate motion detector such as pulse transmitter 16, or by means of retaining roller 21.

In principle only one measurement device is sufficient to measure the longitudinal contours of the piece of timber, but the piece of timber, which may for example be up to 6 m long, must then first pass completely through the measuring device before control can begin. However, this distance is reduced by using several measuring devices in the measuring system, for example two 3 m apart, as shown, or three 2 m apart. A piece of timber 6 m long then has only to be conveyed 3 m or 2 m respectively through the measuring station to be fully measured.

In the rest position contact rollers 22, 23 may be either at a minimum distance apart, smaller than the smallest log diameter, or at a maximum distance apart, greater than the largest log diameter. In the first case the measuring process is initiated by the piece of timber forcing the contact rollers apart; in the second it is inititated by a signalling device such as a photocell arrangement 29 signalling that the top end of the piece of timber has arrived at the last measuring device in the direction of feed, after which all the contact rollers in the measuring system are pressed against the piece of timber.

The same conveyor 20 moves log 10A from measuring station *M* to and through a control station *I* in which the log has the position 10D, and is then fed into a reducer 11 with two reducing discs 15. The centre line C_I of control station *I* coincides with the centre line C_B or reducer 11, and in the example shown also with the centre line C_M of measuring station *M*. Since log 10A, 10D is being carried all the way on a conveyor 20, the speed of its forward motion through control station *I* is equal to its speed in measuring station *M*, and no additional sensors are required. As a general principle, the speed in control station *I* must be unambiguously defined relative to the speed through measuring section *M*.

Control station *I* is adjacent to reducer 11, and is equipped with a control system consisting of two control devices, each comprising a pair of guide rollers 32, 33, which have vertical spindles such as 33a and which, at least in the parts that come into contact with log 10D, resemble the corresponsing parts of contact rollers 22, 23 in measuring station *M*.

In this description, control device, control system etc means the arrangements etc that act upon the piece of timber with the combined effect of positioning it in the required feed attitude and keeping it in that attitude during feeding.

Unlike the contact rollers in the measuring station, the guide rollers in the control station are therefore actuated with such a great force that they are able, despite retaining roller 21', to change the position of log 10D relative to conveyor 20. In the example shown this is achieved by each guide roller or guide roller spindle being carried by the piston rod of double-acting hydraulic cylinder-piston assemblies 34, 35, which are the actuating devices of the control devices. For alignment a device is needed to position the top end of piece of timber 10D (this is the alignment that is often performed in known arrangements). At least one additional control device is required for possible parallel displacement and/or rotation (around an axis perpendicular to its centre line) of the piece of timber. For alignment of short pieces of timber the distance *e'* between two adjacent control devices must be less than the shortest length of a piece of timber, which on the other hand leads to problems with the alignment of pieces of timber of maximum length (6 m). It therefore proves particularly advantageous to use at least three control devices 2 m apart, as shown in Fig. 3.

The activating devices operate in accordance with order signals received from computer system *D*, which produces the order signals on the basis of a stored program and of the signals received from measuring station *M* and pulse transmitter 16. For clarity Fig. 1 shows connections only from computer *D* to the left-hand actuating devices, but obviously there are two corresponding connections to the right-hand actuating devices.

Such signals from the measuring station are shown in the diagram in Fig. 6, where the abscissa represents the travel distance of the piece of timber, and the ordinate the measurement signals. The curve *A* is the midpoint curve of the piece of timber, corresponsing to the expression Y(x), whilst the curve F_1 represents one longitudinal outside contour of the piece of timber and F_2 the other outside contour.

$$\left(y(x) + \frac{b(x)}{2}\right) \qquad (1)$$

$$(y(x) - \frac{b(x)}{2}) \qquad (2),$$

where b(x) represents the width of the piece of timber.

In principle, measurement can be performed in two ways of equal value, either by recording the outside contours and calculating the midpoint and width, or by recording the midpoint and width and calculating the outside contours.

In computer system *D* there is stored in a known manner a program for calculation of optimum yield (which need not always be the greatest yield in volume terms) from a piece of timber for which the measurement signals have been received, and of the feed attitude required to obtain the optimum yield. On the basis of the calculation results, the computer *D* generates order signals to postion the piece of timber in control station *I* to the required feed attitude.

According to the present invention, the computer *D* is equipped with a delay unit *R* to which the generated order signals are first fed, and in which their output from computer *D* is delayed by such an amount that when, for example, a point S' on log 10D passes through control device 32, 32, actuating device 34, 34 of this control device is controlled by an order signal that was generated on the basis of the measurement signal that was produced when the point *S* on log 10A passed through measuring device 22, 22. It can thus be said that the control devices "re-create" the longitudinal contour form of the log that was sensed by the measuring devices, but with the important difference that it is re-created in a corrected, i.e. changed, position relative to the centre line C_I of the control system, compared with the position of the centre line C_v of log 10 relative to the centre line C_M of the measuring station. This change of position is the result of the optimisation calculation performed in computer *D*, so that the basically random position of log 10 in measuring station *M* relative to centre line C_M is now corrected to a calculated optimum position relative to centre line C_I of control section *I*, and therefore also relative to centre line C_B of processing machine 11, which is to say that the required feed attitude has been achieved.

The measurement signals can be used in different ways, depending on the design of the processing machine and the type of control required. Various control possibilities are stated in more detail at the end of this description. They also include the case of zero correction, in which the computer *D* determines that the log 10 was already by change in a position in measuring station *M* corresponding to the required feed attitude in control station *I*.

Fig. 1 shows the log 10D after the position correction has been carried out and the centre line C_v of the log coincides with centre line C_I of the control section, which was not the case relative to the centre line C_M of the measuring station.

In principle the length of the delay in delay unit *R* can be determined in two ways. Either a signalling device, for example a photocell arrangement 39, generates a signal which indicates that the top end of log 10D has arrived at control device 32, 32, this signal is fed to delay unit *R* and causes the order signals to be issued, or the sequence of signals from pulse transmitter 16 is fed to delay unit *R* and is used there, when the program contains the distance between the measuring station and the control station to determine the instant at which the order signals are issued. It should be noted that in the example according to Fig. 1, provided that the speed of conveyor 20 is constant, the log moves at the same speed in positions 10A and 10D. This means that the order signal sequence must be issued at the same rate as the measurement signal sequence was fed in.

At rest, the guide rollers in each pair of guide rollers are the maximum distance apart. At the instant when the top end of log 10D enters the control device 32, 32, closest to the processing machine 11, the issue of order signals from computer *D* starts, and both guide rollers 32, 32, and guide rollers 33, 33, grip log 10D and hold it firmly under the influence of the order signal sequences that are now being supplied to actuating devices 34, 35 during the entire process of feeding into reducer 11. This effectively prevents the unwanted lateral forces occurring in this reducer from laterally deflecting the piece of timber.

Fig. 2 shows an alternative execution in which the measuring station and the control station are arranged alongside each other. The connections to and from computer *D* are indicated only schematically, but are essentially the same as in Fig. 1. Here the measurement and control stations each have their own longitudinal conveyor 20 and 30 respectively. The speed of each conveyor is sensed by pulse transmitters 16' and 16''. These speeds need not be identical, since the relationship between them can be determined in computer *D* on the basis of the signals from the two pulse transmitters 16', 16'', and thus also the correct rate at which the order signals must be issued, for instance in order that, when a reference point *T'* passes through control device 33, 33, the control device is subjected to an order signal that was generated on the basis of a measurement signal obtained when the reference point *T* passed through measuring device 23, 23, regardless of whether conveyors 20 and 30 are moving at equal or differ-

ent speeds.

In principle conveyors 20 and 30 can be mechanically synchronised or coupled together and pulse transmitters 16', 16" can be omitted. But there must then be no sliding or slipping, and this can hardly be guaranteed in practice.

As a consequence of the transverse motion between the measurement and control stations, a signalling device such as a photocell arrangement 39 is essential here to determine when the output of the order signals is to begin.

The above-mentioned transverse motion is achieved in the following manner. Conveyor 20 feeds piece of timber 10A into measuring station *M* in the direction of arrow P_1, with the root end forward. After discharge from the discharge end M_U of the measuring station, the piece of timber arrives in a position 10B on a roller conveyor 37a–37c which extends in the same direction as conveyor 20, and which is crossed by a transverse conveyor which includes three conveyor chains 36a–36c with driver elements. Transverse conveyor 36a–36c may possibly equipped be in a known manner with buffer arrangements to regulate the flow at the required rate.

The transverse conveyor moves the piece of timber in the direction of the arrows P_2 to another conveyor 38a–38c which, driven in the direction of arrows P_3, runs in the same direction as conveyor 30 of control station *I*. The drawing shows the piece of timber in a position 10C just before it has reached the above-mentioned second roller conveyor 38a–38c, by which it is then fed top end first into control station *I* via input end I_i of the control section. The piece of timber moves to position 10D on conveyor 30 and is advanced by conveyor 30 in the direction of arrow P_4, as well as being aligned and guided by control devices 32, 33 in the same manner as described in connection with Fig. 1. Any rotation of the pieces of timber about a vertical axis during travel between conveyor 20 and conveyor 30 is immaterial since it cannot influence the result. On the other hand, the pieces of timber must not rotate about their centre line during this travel, and for this reason the arrangement according to Fig. 2 is best suited for pieces of timber such as boards, planks and blocks, which have a flat surface resting on the conveyor arrangement.

In view of the fact that the piece of timber can be fed through the measurement and control stations at different speeds, it is evident from Fig. 2 that one control station can be combined with or can interact with several measuring stations, or that one measuring station can be combined with or can interact with several control stations. As a general rule, timber can be fed faster through a measuring station than through a control station, since the control station also acts as a feed station, and must maintain a working rate that is determined by the feed rate possible in the processing machine.

Fig. 3 shows another, space-saving execution. A log 10A, which for clarity is shown in the lower part of the drawing, is fed on a single longitudinal conveyor 20 through a combined measuring and control station *MI*, arranged immediately adjacent to processing machine 11. The following devices, in the order corresponding to the direction of motion of conveyor 20, are arranged in the combined station:

a measuring device 41 of essentially the same kind as measuring devices 22, 23, two combined measuring and control devices 42, 43, and a control device of essentially the same kind as control devices 33, 34. The combined measuring and control devices 42, 43 are essentially identical to measuring devices 41, but they can also be subjected to the effect of greater force by reason of the fact that they are each subject to the action both of a weak pressure device such as a spring 43d, and an actuating device such as 43e. All devices in section *MI* are shown to be of a basically known type in which the vertical spindles, such as 41a, of the contact or guide rollers, are fixed to arms such as 41b which in turn are pivoted on spindles such as 41c, and are constantly pressed towards conveyor 20 by weak pressure devices such as coil springs 41d. Control devices 44 are subject not to the action of the above-mentioned weak pressure devices, but to the action of actuating devices such as hydraulic-piston assemblies 34'. These actuating devices, such as actuating devices 43e, are fully comparable with actuating devices 33 and 34, also with regard to control by order signals from computer *D*. When the actuating device is not activated, the combined devices work as measuring devices, and when the actuating device is actuated they work as control devices. The computer is informed of the forward feed rate of the piece of timber either by a motion detector or a signalling device.

The arrangement operates in the following manner. Log 10A is inserted from the side with its top end at device 43, or is fed to this position longitudinally in the direction of arrow P_1, and measurement then starts. During measurement, which is performed by measuring device 41 and by combined devices 42, 43, all these devices operate as measuring devices, and the actuating devices of combined devices 42, 43 and of control device 44 are deactivated. Log 10A is advanced through the arrangement in the direction of arrow P_1. When the top end of the log reaches control device 44, the entire log has been measured and control can begin. Combined devices 42, 43 change over to active control, and control device 44 is also activated. When the rear end of the log passes

device 42 (position 10D), this device is deactivated. When the rear end passes device 43, this device is also deactivated, thus making the system ready to receive the next log. When the rear end has passed device 44, this device is also deactivated.

Figs. 4a and 4b explain in more detail the process of processing planks, boards, blocks etc which possess longitudinally both outside contours *H* and inside contours *G*. Between the outside and inside contours there are inferior waney edge regions *V*. The usable volume is determined by the clear area *B* between the inside contours *G*. The waney edge regions *V* may be very irregular, so that the centre line C_V of the whole piece of wood does not coincide with the centre line C_B of the clear area *B*. Only clear area *B* with delimiting contours *G* is of importance for calculating the optimum yield, and the required feed attitude is that shown in Fig. 4b, where the centre line C_B of the clear area coincides with the centre line C_R of the machine. However, in the control arrangement board 10' can be gripped by control devices 32, 33 only along its outside contours *H*. Thus the optimum yield is calculated on the basis of inside contours *G*, but with order signals for the control devices are generated with respect to outside contours *H*. Consequently both the outside and inside contours must be measured in the measuring system and input to computer *D*.

Fig. 5 shows measurement of the inside contours in two basically known manners. Either mechanical sensors in the form of contact wheels 24 with bevelled surfaces, or a non-contacting optical sensor 45 may be used. The vertical spindles of the contact wheels are mounted on pivoted arms in the same way as arms 41b in Fig. 3, and a known measuring system of this kind is described for example in German patent application 27 06 149. The optical sensor 45 is in principle a camera with an objective 46 and an array 47 of light-sensitive devices in the focal plane. A known measuring system of this kind, which is described for example in Swedish patent specification 381.334, can measure the inside and outside contours at the same time, so that a measuring section according to the present invention can be equipped only with such measuring systems. The mechanical measuring system shown must be supplemented with a measuring system for the outside contours, but mechanical measuring systems that measure both the inside and the outside contours have already been proposed.

Obviously the measuring and control devices need not be of the same type; an optical measuring device may be used alongside a mechanical control device. The essential requirement is that the measuring devices relative to each other and the control devices relative to each other should be equally spaced in the longitudinal direction of the piece of timber. It is also essential that each measuring and control device has a known position relative to the centre lines of the sections in question, even if, as Fig. 2 shows, the centre lines of the measuring and control sections need not coincide. The opening width measured in the measuring system (the distance between contact rollers 22, 23, 41 within a pair) corresponds to the diameter of the piece of timber, and can be used to advantage for automatic setting of the tools in processing machine 11, for example to set the positions of reducing disc 15 relative to each other.

The delay in computer *D* can also be achieved by delaying the input measurement signals before calculation operations are performed, and by then issuing the order signals immediately.

In conclusion, with reference to Fig. 6 and to formulas (1) and (2), seven typical cases will be described, in which y^k represents the order signal to the control devices, *y* represents the measurement signal from the measuring devices and y_N a polynomial of degree *N*:

1) $y^k = 0$ No correction signal. The piece of timber is processed along the midpoint curve corresponding to a fixed control device. During processing it is subject to large lateral forces caused by irregularities in its outside contours. This is the conventional method, the disadvantages of which it is the purpose of the present invention to eliminate.

2) $y^k = y$ The correction signal is equal to the measurement signal. The piece of timber is processed along the centre line of the measuring section, i.e. the lateral position of the piece of timber relative to the processing machine is not changed. This corresponds to a feeding-in arrangement designed in such a way that the piece of timber is fixed on the feed conveyor, a method that leads to relatively complex arrangements when known technology is used.

3) $y^k = y - y_o$ (y_o = constant) The difference between this and case 2) is that a "best" lateral displacement is calculated, and the piece of timber is processed in a position displaced parallel relative to the centre line of the measuring station. In the present description "best" (adaptation) means an adaption of a function expression to a given curve such that the spread is as small as possible. The dimension of the spread can be defined in different ways, for example by the least squares sum of all devitions or as the

smallest maximum deviation, or by means of a calculation based on the width information obtained at the same time as the midpoint curve. It is also fully conceivable that other measuring systems measure other para meters of the piece of timber and a "best" processing curve is calculated, which is fed to the feeding system according to the present invention.

4) $y^k = y - y_1$ ($y_1 = c_0 + c_1x$, ... $c_0 c_i$ = constant) The difference between this case and case 3) is that a "best" rotation is calculated and the piece of timber is processed in a parallel-displaced and rotated position relative to the centre line of the measuring station.

5) $y^k = y - y_2$ ($y_2 = c_0 + c_1x + c_2x^2$, ... c_0, c_1, c_2 = constant) The difference between this and case 4) is that a "best" parabola is calculated and the piece of timber is now continuously turned while being processed. This is a form of curve-sawing.

6) $y^k = y - y_3$ ($y_3 = c_0 + c_1x + c_2x^2 + c_3x^3$, ... c_0, c_1, c_2, c_3 = constant) The difference between this and case 5) is that a "best" cubic arc is calculated. The curved sawing follows the midpoint curve of the piece of timber better, but this method can lead to larger and more abrupt curves on the processed piece.

7) $y^k = y - y_N$ ($N > 3$, high-degree polynomial) When N is increased, the "best" curve is made to approximate increasingly to the measured midpoint curve, i.e. $y \approx y_N$, which gives $y^k \approx 0$, which finally leads to $y^k = 0$, which has already been dealt with in case 1). (A polynomial has been used here to describe the correction signal, even though this is not necessary, but it is the commonest and most effective form of function expression).

CLAIMS

1. Method for feeding pieces of timber into a timber processing machine, in which a measuring system longitudinally measures the contours of the piece of timber, and the measurement result is input in the form of electrical measurement signals to a computer system in which, on the basis of these signals and a stored optimisation program, are calculated both the optimum yield that can be obtained from the piece of timber, and the attitude in which the piece of timber must be fed into the processing machine to achieve this yield, and electrical order signals are generated for aligning the piece of timber with the above-mentioned necessary attitude, wherein

—the piece of timber is advanced longitudinally on a conveyor arrangement relative to which it is positionally fixed, through the measuring system along the centre line of the conveyor arrangement, and is further conveyed from the measuring system to a control system situated closely adjacent to the processing machine,

—the piece of timber is advanced longitudinally through the control system along the centre line of the control system, which coincides with the centre line of the processing machine, at a rate defined relative to the feed rate through the measuring system,

—the measurement results from the measuring system, containing information on the longitudinal contours of the piece of timber, including the outside contours, and on the position of the said contours relative to the centre line of the measuring system, are input to the computer system in the form of at least one continuous sequence of longitudinal contour signals,

—the control signals are output from the computer in the form of at least one continuous sequence and are fed to the above-mentioned control system for operating its control devices with a delay corresponding to the time taken by a reference point on the piece of timber of travel from a reference point in the measuring system to the corresponding reference point in the control system so that when the piece of timber passes through the control system the external longitudinal contour shape determined in the measuring system is re-created in the control system, but, relative to the centre line of the control system, in a position corrected by calculation in the computer system to the above-mentioned necessary feed attitude, and

—the piece of timber is fed into the processing machine under forced control by the thus-operated control devices, which are each subjected by an actuating device with sufficient force for lateral guiding of the piece of timber.

2. Method according to claim 1 for machining of pieces of timber such as planks and boards which possess longitudinally, in addition to outside contours, also inside contours, wherein both the outside and inside contours are measured in the measuring system and the measurement results are input to the computer system in the form of at least one continuous sequence of outside contour signals and at least one continuous sequence of inside contour signals, and wherein the yield calculation is performed in the computer system on the basis of the inside contour signals, whilst the control signals for the control system are obtained with reference to the outside contour signals and on the basis of the result of this calculation.

3. Method according to claim 2, wherein at least some of the longitudinal contours of

the piece of timber are measured optically in the measuring system.

4. Method according to any one of the preceding claims, wherein at least some of the longitudinal contours of the piece of timber are measured mechanically in the measuring system by means of measuring devices which act upon the piece of timber with such a small force that the position holding of the piece of timber relative to the conveyor arrangement is not affected, and which, at least in the part that acts upon the piece of timber, advantageously have the same form as the part of the control, device or devices that acts upon the piece of timber.

5. Method according to any one of the preceding claims, wherein measurement is performed in at least one measuring station situated at a distance from the processing machine, and alignment is performed in at least one control station separate from the measuring station or stations.

6. Method according to claim 5, wherein the piece of timber is fed into the measuring station with its root end forward, is transferred laterally between the measuring and control stations, and is fed into the control station with its top end forward.

7. Arrangement for feeding pieces of timber into a timber processing machine by the method according to any one of the preceding claims, the arrangement comprising at least one measuring arrangement to measure the contours of each piece of timber in the longitudinal direction, an alignment arrangement to align the piece of timber to a feed attitude necessary for optimum yield, a computer system to which the measuring and alignment stations are connected and which is arranged to receive measurement signals from the measuring system or systems and to process the measurement signals with the aid of a stored optimisation program into control signals to operate alignment devices in the alignment arrangement so that the piece of timber is aligned to the said necessary feed attitude, and at least one conveyor arrangement to advance the pieces of timber, wherein

—the measuring system comprises a conveyor arrangement to advance the piece of timber longitudinally and in a state in which its position is fixed, through the measuring system along the centre line of the measuring system, and at least one measuring device to measure tho contours of the piece of timber in the longitudinal direction and to send the measurement results to the computer system in the form of at least one continuous sequence of measurement signals,

—closely adjacent to the processing machine there is arranged a control system which comprises, on the one hand, a conveyor arrangement to advance the piece of timber longitudinal through the control system along the centre line which coincides with the centre line of the processing machine and for feeding the piece of timber into the processing machine, and on the other hand at least one control device which is powered by an actuating device that can be operated by control signals from the computer system, with a force sufficient to displace the piece of timber laterally on the conveyor arrangement and to hold the piece of timber firmly under the action of lateral force acting upon it in the processing machine during processing,

—the computer system is arranged to output the control signals in the form of at least one continuous sequence of control signals and comprises a delay unit to delay the said output of control signals to the control system by a time corresponding to the time required for a reference point on the piece of timber to travel from a reference point in the measuring system to a corresponding reference point in the control system.

8. Arrangement according to claim 7, including at least one motion detector connected to the computer system to measure the forward motion of the piece of timber through the measuring and control systems as a basis for determining the above-metioned travel and delay times.

9. Arrangement according to claim 7 or 8, wherein the measuring system comprises measuring devices to measure both the outside contours and the inside contours in the longitudinal direction of a piece of timber and to issue at least one continuous outside contour signal sequence and at least one continuous inside contour signal sequence, and in the computer system is arranged to perform the yield calculation on the basis of the inside contour signal sequence or sequences and to produce the control signal sequence or sequences on the basis of the result of this calculation and with reference to the outside contour signal sequence or sequences.

10. Arrangements according to any one of claims 7–9, wherein at least one of the measuring devices in the measuring system is an optical measuring device that operates without contact.

11. Arrangement according to any one of claims 7–10, wherein at least one of the measuring devices in the measuring system is a mechanical measuring device that acts upon the piece of timber with such a small force that the position fixing of the piece of timber on the conveyor arrangement is not affected.

12. Arrangement according to claim 11, wherein the said measuring device has at least in the part that acts upon the piece of timber the same form as the part of the control device or devices in the control system that acts or act on the piece of timber.

13. Arrangement according to any one of claim 7–12, wherein the measuring device or devices are arranged in at least one measuring station situated at a distance from the process-

ing machine and the control device or devices are arranged in a control station arranged immediately adjacent to the processing machine.

14. Arrangement according to claim 12, wherein in a combined measuring and control station arranged immediately adjacent to the processing machine at least one measuring device, at least one combined measuring and control device and at least one control device are arranged in the stated order, the combined device being arranged to be able to operate selectively as a measuring device acting upon the piece of timber with a low pressure and as a control device acting upon the piece of timber with a higher pressure.

15. Arrangement according to claim 14, wherein there are arranged in the control station at selected distances apart, in the direction of feed of the piece of timber: one measuring device, two combined measuring and control devices and one control device.

16. Arrangement according to claim 13, wherein the measuring station or stations are positioned alongside each other and so that the output end of the measuring station or stations is adjacent to the input end of the control station or stations and a transverse conveyor arrangement is arranged to move the pieces of timber between the said ends of the stations.

17. Arrangement according to any one of claims 7–16, wherein the control devices, the combined measuring and control devices and where applicable the mechanical measuring devices comprise a pair of interacting contact rollers have vertical spindles and a cylindrical or bevelled surface for contact with the piece of timber.

18. Arrangement according to any one of claims 7–17, wherein the actuating devices for the control devices or for the combined measuring and control devices are double-acting cylinder-piston assemblies supplied with a pressure medium.

19. Arrangement according to any one of claims 7–18, wherein the distance between measuring devices and between control devices or the combined measuring and control devices is 2 m.

20. A method for feeding pieces of timber into a timber processing machine substantially as herein described with reference to the accompanying drawings.

21. An arrangement for feeding pieces of timber into a timber processing machine constructed, arranged and adapted to operate substantially as herein described with reference to, and as shown in, the accompanying drawings.

22. A product made by or with the use of a method according to any one of Claims 1 to 6 or 20.

23. A product made by or with the use of an arrangement according to any one of Claims 7 to 19 or 21.

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